

MORE METEORITE EVIDENCE

Extraterrestrial amino acids

Last December's report by a group from the National Aeronautics and Space Administration's Ames Research Center of finding indigenous amino acids in the Murchison meteorite (SN: 12/5/70, p. 429) has sparked intense scientific interest. The finding was subsequently confirmed by groups from the University of Houston (SN: 3/20/71, p. 195) and Arizona State University (SN: 3/27/71, p. 210).

The Arizona State scientists, Drs. John R. Cronin and Carleton B. Moore, also reported detecting the same amino acids in an intact piece of a similar meteorite that fell near Murray, Ky., in 1950. Now the leader of the NASA group, Dr. Cyril Ponnamperna, confirms an abundance of amino acids in the Murray meteorite. Dr. Ponnamperna told a meeting of the New York Academy of Sciences last week that the group's use of gas chromatography combined with mass spectrometry detected all 18 of the amino acids in Murray that they earlier found in Murchison. They also found the same two pyrimidines—4-hydroxypyrimidine and 4-hydroxymethylpyrimidine—in each meteorite. The

pyrimidines differ slightly from those found in nucleic acids in living cells.

The coincidence to the finds is further strong evidence that the amino acid and pyrimidines were created chemically in space. Although he can only speculate, Dr. Ponnamperna suggests that the existence of identical complex patterns of amino acids and pyrimidines in two meteorites could mean that this is a basic phase in the chemical process leading to life. The findings increase the likelihood of life elsewhere in the universe.

In both meteorites, six of the amino acids are among those that are commonly linked together to form proteins in living cells; the other 12 are amino acids only occasionally found. They are thus not likely to result from terrestrial contamination. The amino acids are of an almost equal mixture of right- and left-handed molecular structures. Earth organisms produce only left-handed amino acids. The mixture of both types thus appears to rule out biological origin and is strong evidence for extraterrestrial chemical origin.

Members of the Ames team also included Drs. James Lawless, Keith Kvenvolden, Clair Folsome and Miss Etta Peterson. ASU's Dr. Moore also took part.

Cyclops: Eye on the universe

For a total of 150 hours from May through July of 1960 the 85-foot antenna at the National Radio Astronomy Observatory in Green Bank, W.Va., monitored radio emissions from the nearby stars Tau Ceti and Epsilon Eridani for any evidence of signals from intelligent extraterrestrial civilizations. The search, Project Ozma, turned up nothing unusual. But it was the first time man had tried to detect signals from any unknown counterparts on other planetary systems.

Last week engineers and scientists gathered at the National Aeronautics and Space Administration's Ames Research Center in Mountain View, Calif., to explore the technological possibilities of a project that would be orders of magnitude more sophisticated than Ozma. The 11-week study, sponsored jointly by Ames and Stanford University, is called Project Cyclops. Its aim is to examine feasibility and to educate, not to recommend policy. There is no intention of inaugurating such a project at this time. Decades might pass before it is possible. But the study co-directors, Dr. Bernard M. Oliver, vice president for research of the Hewlett-Packard Co., and a

visiting professor at Stanford, and Dr. John Billingham, chief of the biotechnology division at Ames, believe it is not too early for a fuller study of the technology necessary to detect artifact signals.

Basically, Cyclops envisions an interconnected array of 1,000 to 10,000 radio telescope dishes spread over an area perhaps 10 miles across. Such an array should, according to one estimate, be able to detect beamed signals from any civilization within 1,000 light-years. Normal radio "leakage" from the regular transmissions of advanced technological civilizations might be detectable from perhaps 100 light-years. The costs of such an array would have to be justified by the signal search itself, but the array would also be an excellent tool for radio astronomy. One goal of the study is to explore ways in which the dishes could be produced cheaply enough to make the idea feasible. "We would like to nail down the cost of doing this," says Dr. Oliver.

As for the Cyclops array itself, "its mission would be to add a new dimension to cosmology," Dr. Oliver says. "It might establish the science of biological cosmology."

BEHAVIOR

Whatever happened to UFO's?

On May 31 two New Hampshire farmers looked across a field and saw a spherical, flat-bottomed object hovering above the ground. As they watched, the object rose vertically, arced and headed into the wind on a horizontal path.

This is one of several incoming reports of unidentified flying objects received recently by the National Investigations Committee on Aerial Phenomena (NICAP) in Washington. NICAP secretary-treasurer Stuart Nixon says he believes the reports may be the start of a recurrence of saucer sightings or at least the reporting of saucer sightings. NICAP has been a long time waiting. Since 1968 the number of UFO sightings has dropped off, along with public interest in them. Last week a Wall Street Journal article reported that a probable reason for the decline is the negative social climate produced by publication in 1968 of the Condon report, the 810-page scientific study of UFO sightings commissioned by the U.S. Air Force and directed by Dr. Edward U. Condon of the University of Colorado. It concluded that "nothing has come from the study of UFO's in the last 21 years that has added to scientific knowledge." And "that further extensive study of UFO's probably cannot be justified in the expectation that science will be advanced thereby."

This scientific debunking of the UFO phenomena and the subsequent, though not necessarily connected, decline in sightings presents an interesting behavioral pattern. Dr. Ernest R. Hilgard, a Stanford University psychologist who served on the National Academy of Sciences panel that reviewed the Condon report, believes the report itself is not wholly responsible for the falling off of flying saucer interest. "I would like to feel that the report quieted the saucer interest," he says, "but I do not think so." People probably just lost interest, he suggests. "These fads go in cycles," he explains, and many persons who would have been interested in extraterrestrial phenomena have turned to other things: drugs, astrology, Oriental religions and various subjective and philosophic fields. As society becomes more affluent man has time to reflect on his position in the universe. As he does so he attempts to integrate himself into and make himself a more important part of that universe. Belief in other worldly things is one method of doing so, points out Dr. Hilgard. But national and international events of the past few years have tended to make people look inside rather than outside themselves for answers to universal questions. This fad too will pass, says Dr. Hilgard, who predicts

that the UFO's will reappear when it does. At NICAP Nixon says UFO reports usually run in five-year cycles and 1972 should be the start of another cycle.

Dr. Donald I. Warren of the School of Social Work at the University of Michigan in Ann Arbor has another behavior theory on UFO's. In his view UFO's provide a form of escape. "One expression of this escape," he says, "is the possibility of other lives, other planets, other beings like or unlike oneself." UFO's "present the opportunity to escape the system without threatening one's gains in the immediate social environment." Dr. Warren, however, based his conclusions on a person's dissatisfaction with his socioeconomic status. A well-educated person earning a relatively small salary might not be content in his situation and would therefore, suggests Dr. Warren, be a likely person to attach importance to himself

by believing in and sighting flying saucers.

This theory may have some credibility, but an article by Dr. Warren in *SCIENCE* last November advancing these views received a critical response from scientists. The controversy, brought on by a lack of adequate psychological and behavioral information on the subject, points out, as does Dr. Warren, "that this phenomenon has been inadequately studied by the behavioral sciences."

In an attempt to coordinate existing information, NICAP has instituted Project ACCESS (Automated Clearinghouse for Collection and Exchange of Sighting Statistics). All available sighting data (people, places, times, etc.) will be stored in a computer and made available to interested parties. If, these inputs are scientific and objective, as NICAP's Nixon insists they will be, Project ACCESS will be a useful tool for behavioral scientists. □

Nuclear power safety

The Atomic Energy Commission last week announced new, stricter criteria for nuclear power plant safety. Prime emphasis in the new standards is the need for back-up systems in case cooling water systems for reactors fail. Such an accident could conceivably result in overheating of reactor cores, melting of shielding and release of radioactivity. Most affected by the new criteria are five plants licensed before 1968. They will have to install the back-up systems within three years. □

California's AEC ties

The huge University of California system has been heavily involved in defense and weapons research since World War II. Partly in response to student-faculty criticisms (SN: 1/16/71, p. 50) the UC regents last week recommended changes in the contractual arrangement between UC and the Atomic Energy Commission under which the Lawrence Radiation Laboratory is operated. The laboratory consists of two units, the non-secret facility on the hill behind the Berkeley campus and the more closely guarded facility at Livermore. Under the recommendations, the administrative ties between the two units would be severed. And the director of the Berkeley laboratory would report directly to the president of the university rather than, as now, to the chancellor of UC at Berkeley. □

Doctorate oversupply

A new National Science Foundation study on the supply of and demand for doctoral scientists, projected to 1980, indicates an even greater imbalance of supply over demand than in a study done two years ago. Over-all projections show a supply of about 325,000 doctoral scientists in 1980—against an expected demand for about 285,000. The greatest imbalance is in engineering, with a projected 40 percent oversupply. Next greatest is in social sciences, with a 20 percent oversupply. The life sciences situation is somewhat better, with a 9 percent oversupply predicted. Mathematics will see an oversupply of around 10 percent. Only in the physical sciences will supply and demand be essentially in balance. □

Oldest mummy

Possibly the oldest (5,000 years) intact mummy ever found has been unearthed in a tomb in Sakkara, 15 miles southeast of Cairo. The ancient court musician Nofre died in the sixth year of the reign of King Nie Ossen-Ra. The discovery was called historically and scientifically more important than the findings of the Tutankhamen tomb in 1922. □

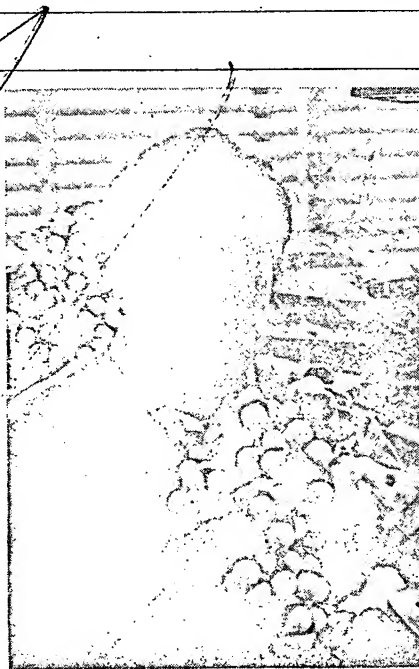
DRUG ACTION ON DNA

Now visible, in 3-D

For some years scientists have zeroed in on drug action at the most intricate cellular level. Although they understand the molecular basis of action for several drugs, it is only now that the three-dimensional structure of a drug has been correlated with its biological action.

Dr. Henry M. Sobell of the University of Rochester reported last week that by using the technique of X-ray crystallography, he has pinpointed exactly how the antibiotic actinomycin D interacts with DNA. In fact, since the Crick-Watson model for DNA was proposed 18 years ago, this is the first time scientists know visually how anything sticks to DNA.

Dr. Sobell, a physician-turned-crystallographer, says he crystallized actinomycin with deoxyguanosine, one of the four bases of DNA. The three-dimensional structure of the complex immediately suggested how actinomycin binds to DNA. Dr. Sobell believes that the flat portion of the drug molecule fits in between the nucleotide base sequence, GpC, while the protein subunits of the antibiotic make a hydrogen bond with guanine residues on either strand of DNA. Actinomycin has two-fold symmetry relating to the protein subunits. This enables the drug to bind to a base sequence in DNA with two-fold symmetry. This pattern of recognition was first conceived several years ago by Dr. Jacques Monod, who shared the 1965 Nobel Prize with Drs. Francois Jacob and Andre Lwoff for their work in biological regulation. Dr. Sobell's report of the first visual sighting of the drug-gene contact was made in San Francisco at the 62nd annual meeting



Univ. of Rochester

Sobell and drug-DNA molecule model.

of the American Society of Biological Chemists.

The medical implications of Dr. Sobell's work may be far-reaching. Actinomycin's repressor-action on DNA, as revealed in the crystal model, might explain why actinomycin works as an antitumor drug. However, the drug is too toxic for lavish clinical control of tumors, precisely because of its stringent action at the molecular level. But now that scientists understand how actinomycin binds to DNA, Dr. Sobell believes they can probably synthesize new antibiotics or drugs that would act on tumor cells or viruses, but not on cells, in the rest of the body. □

UFO

AN APPRAISAL OF THE PROBLEM

A Statement by the UFO Subcommittee of the AIAA

To gain a fresh and objective perspective on the UFO problem, the UFO Subcommittee of the AIAA, from its inception in 1967, decided to place specific, well-defined questions to UFO experts of high scientific qualifications but strongly divergent views. Surprisingly, the factual answers the Subcommittee obtained in a series of interesting interviews were strikingly similar. Differences occurred in certain quantitative estimates and in the degree of emphasis, but not in principle.

It was at the next step where the views began to diverge: subjective judgment as to the scientific significance of the problem and the need to pursue and explore it. Obviously, such opinion depends on the criteria applied by the individual, and much of the discord appears to be due to a lack of analysis of these criteria. It is at this stage where guesses and speculations creep into the discussion and lead to controversy.

In the opinion of the UFO Subcommittee, such speculations are entirely premature and no position is absolutely defensible at this point in time. This applies specifically to statements that the extraterrestrial hypothesis ("ETH") is "the least probable" or "the least unprobable" explanation (National Academy of Sciences, Review of the "Condon Report"; James E. McDonald's statements). There is no scientific basis for assessing such probabilities at this time.

The Subcommittee was greatly perturbed by the paucity of thorough scientific and technological analysis applied to practically all observations before the Condon study. The few, often courageous, efforts by individuals to come to grips with this problem should be viewed more from an aspect of focusing attention on the problem rather than of solving it, since there is little doubt that it takes more than a personal effort to investigate fully a problem of such complexity.

In the opinion of the committee, the Colorado University study, "Scientific Study of Unidentified Flying Objects," (the "Condon Report," Bantam Books, New York, 1969) at this time represents the most scientifically oriented investigation published on the UFO problem. Attacks directed against the study seem to overlook the almost insurmountable difficulties which a short time ago were projected as this type faces: building up the multi-

disciplinary, unbiased talent, accumulating practical experience, collecting hard information, sorting out the signal from the noise, applying the best analytical methods, and writing and editing a report in less than two years.

To understand the Condon report, which is difficult to read, due in part to its organization, one must study the bulk of the report. It is not enough to read summaries, such as those by Sullivan and by Condon, or summaries of summaries, on which the vast majority of readers and news media seem to rely. There are differences in the opinions and conclusions drawn by the authors of the various chapters, and there are differences between these and Condon's summary. Not all conclusions contained in the report itself are fully reflected in Condon's summary. For example the optical/radar chapter contains the following statement on the Lakenheath case (1956):

The apparently rational, intelligent behavior of the UFO suggests a mechanical device of unknown origin as the most probable explanation of this sighting. However, in view of the inevitable fallibility of witnesses, more conventional explanations of this report cannot be entirely ruled out.

On Colorado Springs case (1967):

In view of the meteorological situation, it would seem that AP (anomalous propagation) was rather unlikely. Besides, what is the probability that an AP return would appear only once and at that time appear to excite a perfect practice ILS approach.

Condon's own conclusions have been widely misquoted. He says:

"... Scientists are no respecters of authority. Our conclusion that study of UFO reports is not likely to advance science will not be uncritically accepted by them. Nor should it be, nor do we wish it to be. For scientists, it is our hope that the detailed analytical presentation of what we were able to do, and of what we were unable to do, will assist them in deciding whether or not they agree with our conclusions. Our hope is that the details of this report will help other scientists in seeing what the problems are and the difficulties of coping with them.

"If they agree with our conclusions, they will turn their valuable attention and talents elsewhere. If they disagree, it will be because our report has helped them reach a clear picture of wherein existing studies are faulty or incomplete and thereby will have stimulated ideas for more accurate studies. If they do get such ideas and can formulate them clearly, we have no doubt that support will be forthcoming to carry on with such clearly defined, specific studies. We think that such ideas for work should be supported.

"... Therefore we think that all of the agencies of the federal government, and the private foundations as well, ought to be encouraged to support such studies along with the others submitted to them on

an open-minded, unprejudiced basis. While we do not think at present that anything worthwhile is likely to come of such research each individual case ought to be carefully considered on its own merits."

Condon's chapter, "Summary of the Study," contains more than its title indicates; it discloses many of his personal conclusions. Making value judgements was no doubt one reason why Condon was asked to handle the project. One is happy to obtain the judgement of so experienced and respected a man; but one need not agree with it. The UFO Subcommittee did not find a basis in the report for his prediction that nothing of scientific value will come of further studies.

In reviewing the material accumulated to date, the Subcommittee found an exceedingly low signal-to-noise ratio, as illustrated by the statistics of the Air Force's Project "Bluebook" quoted in the University of Colorado study, which showed 3.3% unidentified observations (253 out of 7741 available at that time*). This figure is frequently disputed, but its order of magnitude (5%) appears to be correct, taking all available reports into account. The fact that the Condon study itself arrives at a much higher percentage of unexplained cases—namely, at about 30% (35 out of 117)—is primarily due to the preselection of specific cases for investigation. The precise figure is hard to assess, for the Condon report does not lend itself easily to this type of analysis, the same cases being treated often in different sections and under different identifications. (*The final figures, according to our information, appear to be 701 out of 12,618 or 5.5%.)

It has been variously estimated that the reported cases, approximately 20,000, represent only 5 to 15% of the total observations, since most observers either do not go to the trouble of an official report or fear ridicule. In turn, various polls suggest that 3 to 5% of the U.S. population claim to have seen UFOs. It follows, then, that the available reports which can be classified as "unidentified" represent a very small percentage of all UFO sightings on the one hand, but not a negligible number of observations on the other.

It is interesting that, contrary to public opinion, the estimated percentage of "hoaxes" is likewise small. The vast majority of UFO sightings can be ex-

75%) while 15 to 20% contain insufficient data. In other words, what may appear to the untrained observer as strange and unexplainable is in most cases known and explainable.

Taking all evidence which has come to the Subcommittee's attention into account, *we find it difficult to ignore the small residue of well-documented but unexplainable cases which form the hard core of the UFO controversy.* They represent only a small fraction of the "unidentified" cases and are characterized by both a high degree of credibility and a high abnormality ("strangeness" in Hynek's terminology). Although none of them offers to our knowledge quantitative recordings by calibrated instruments for permanent inspection, they are often called "hard cases."

The Subcommittee has tried to explore the nature of this hard-core residue and found estimates to vary between 10 and several hundred cases, depending in part on a subjective judgment as to the criteria for a "hard case." High credibility is generally accepted for observations by multiple independent witnesses of known and reliable background or by multiple independent sensing systems (reported by multiple independent operators) or both; high abnormality or strangeness, when no known natural phenomena whatsoever seem to fit the observations. It is clear, then, that the hard-core residue represents less than 1% of the total available reports.

Those used to working under controlled laboratory conditions find it difficult to consider seriously any observation which is not available in recorded form for quantitative inspection. As a matter of fact, they make this a criterion for a "hard case." On the other hand, there are those, including some members of this Subcommittee, familiar with the intricacies of research in the complex and uncontrolled laboratory of the atmosphere, who find this less of a deterrent. They discover parallels between the UFO problem and certain atmospheric phenomena which fall in the class of rare events. A rare event always involves at first a question of the reality of a qualitative observation. Later, scientific investigation, usually combining statistics and physics, resolves this question one way or the other.

Although the University of Colorado report deals only with a very small fraction of the existing observational material (less than 1%), it offers itself enough substance of the described

tion extracted by McDonald is added to some of the cases. In fact, the Subcommittee finds that the opposite conclusion could have been drawn from its content, namely, that a phenomenon with such a high ratio of unexplained cases (about 30%) should arouse sufficient scientific curiosity to continue its study.

The issue seems to boil down to the question: Are we justified to extrapolate from 0.99 to 1.00, implying that if 99% of all observations can be explained, the remaining 1% could also be explained; or do we face a severe problem of signal-to-noise ratio (order of magnitude 10^{-2})?

In the opinion of the Subcommittee, this question must be asked critically and objectively in each individual case. In cases which do not fit the extrapolation alternative, the further question should be explored: "Do they evidence common attributes?" It appears to the Subcommittee that the University of Colorado group has made no serious attempt in this direction.

If it is already difficult to reach a consensus on what constitutes a hard case, it appears even more difficult to find agreement on the advisability and importance of continued research. As mentioned earlier, it is at this point where the controversy often becomes heated because criteria for such assessment are not well-defined.

Earlier, Condon's statement was quoted that "clearly defined, specific studies . . . should be considered and supported." In this connection he calls attention to "important areas of atmospheric optics, including radiowave propagation, and of atmospheric electricity in which present knowledge is quite incomplete. These topics came to our attention in connection with the interpretation of some UFO reports, but they are also of fundamental scientific interest, and they are relevant to practical problems related to the improvement of safety of military and civilian flying."

The Subcommittee finds this statement of the Condon report a better criterion for support of UFO-related studies than the claim by some ETH exponents that UFO research deserves maximum support as long as there is a ghost of a chance that UFOs are extraterrestrial vehicles, or the opposite claim that proof for the ETH must be provided before serious consideration of the UFO problem is justified. Both opinions strike the Subcommittee as unwarranted.

We have already expressed our disenchantment with arguments about

the possibility of the extraterrestrial origin of UFOs, since there is not sufficient scientific basis at this time to take a position one way or another. However, in view of the infancy of our scientific and technological knowledge (approximately one century), the Subcommittee would agree with this statement by Condon: "We must not assume that we are capable of imagining now the scope and extent of future technological development of our own or any other civilization, and so we must guard against assuming that we have any capacity to imagine what a more advanced society would regard as intelligent conduct." On the other hand, we find no convincing basis for his statement, "It is safe to assume that no ILE (intelligent life elsewhere) from outside of our solar system has any possibility of visiting Earth in the next 10,000 years." (When does one start counting?)

The question arises whether there is a need at all to speculate on a specific hypothesis, such as ETH, in order to decide on the significance of a scientific problem, or whether any known phenomenon in nature is worth investigating. We think it is, but we recognize at the same time that the UFO problem may require expensive tools of technology. Therefore, the question of cost, priority, and relative importance of this problem within the total spectrum of research cannot be overlooked.

The UFO Subcommittee feels that the ETH, tantalizing though it may be, should not be dragged into this consideration as it introduces an unassessable element of speculation; but the Subcommittee also strongly feels that, from a scientific and engineering standpoint, it is unacceptable to simply ignore substantial numbers of unexplained observations and to close the book about them on the basis of premature conclusions.

There is an interesting parallel between the history of the UFO problem and the history of weather modification ("rainmaking"). After almost 20 years of taboo by the scientific community, weather modification has now achieved scientific recognition due to the fact that some courageous, high-caliber scientists entered the arena. This has resulted in a revision of the viewpoint of the National Academy of Science.

The immediate question is how to attack the UFO problem without the pitfalls of past attempts. There is little doubt that the short-time, one-shot approach of an *ad hoc* team is neither promising nor economical. This is es-

BACKGROUND

At the suggestion of the AIAA management, the Technical Committee on Atmospheric Environment and the Technical Committee on Space and Atmospheric Physics jointly formed a UFO Subcommittee in 1967.

The Subcommittee was asked to arrive at an unbiased assessment of the present situation and to serve as a focal point in the AIAA for questions regarding the UFO problem. In appointing the Subcommittee, special care was taken to insure that none of its members was committed one way or another on this issue.

In its attempt to get to the heart of the matter, the Subcommittee naturally found the UFO problem complicated and often buried in what appeared to be a maze of preconceptions, emotions, bias, hasty conclusions, and excessive and misleading publicity.

The Subcommittee soon recognized that it is much too early to expect a meaningful interpretation of UFO phenomena. Rather than enter the arena of speculation, it directed its efforts toward finding out whether or not a scientific problem exists at all. The accompanying report describes the approach the Subcommittee took and the results it obtained. —J.P.K.

AIAA UFO SUBCOMMITTEE

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pecially true if the study team decides—as the University of Colorado group did—to concentrate on current rather than past observations. As the UFO statistics show, this results in the devotion of precious time to investigating the noise, rather than the signal. It was mentioned earlier that the Colorado University study faced formidable odds because of the short duration of its contract. If the com-

mendation of the O'Brien committee to negotiate multiple contracts for continuing investigations had been followed, this difficulty would perhaps have been avoided. There is also little hope to expect a solution of this extremely complex problem by the efforts of a single individual.

The Subcommittee sees the only promising approach as a continuing, methodical effort with many

on improved data collection by objective means and on high-quality scientific analysis. This would eliminate the difficult problem of witness credibility. An economic and technically sound approach involving available remote-sensing capabilities and certain software changes will require some thinking on the side of the aerospace engineering community. Proposals along this line are already in the hands of the Subcommittee. The financial support should be kept at a moderately low level (It is estimated that a small fraction of the costs of the University of Colorado study would be required initially) until reevaluation of the situation allows another assessment. Without such an effort the controversy can be expected to suffer further polarization and confusion.

The Subcommittee feels that a strictly scientific-technological view of the UFO problem leads to this conclusion and that, for a technical committee, there is no need to stress the public and social aspects of the UFO controversy, which may have subsided only temporarily and will continue to clamor for a more conclusive and convincing answer. The Subcommittee is aware of several books on UFOs to be published in the near future. What is needed now is a *moratorium* in the UFO discussion—with an objective, wait-and-see attitude on the part of the scientific and engineering community, the government, and the public.

The approach recommended by this committee requires not only the attention of the scientist and engineer, but also a readiness of government agencies to consider sound proposals in this field without bias or fear of ridicule and repercussion—or, as Condon expresses it, “on an openminded, unprejudiced basis.” This perhaps is our most important conclusion.

Finally, the Subcommittee believes the decision by the Air Force to divorce itself from the UFO problem should be completed by allowing the files to be archived by a civilian agency, either government or university, after proper safeguards for the protection of witnesses and their names as well as full declassification procedures.

This Subcommittee intends to publish additional information on the UFO problem in the AIAA journals to give the members of AIAA an opportunity to form their own opinion. This information will include typical examples of the so-called “hard-core residue” and some potential engineering approaches to a solution of the

E. U. CONDON

UFOs I Have Loved and Lost

Professor Condon conducted a study of Unidentified Flying Objects, from late 1966 to the summer of 1968, at the request of the U.S. Air Force. The full report has been published under the title, "Scientific Study of Unidentified Flying Objects," in paperback by Bantam Books, and in hardback by E. P. Dutton and Co. This article is based on a talk presented before the American Philosophical Society last April. The author is professor of physics at the University of Colorado.

Throughout human history men have been seeing strange and terrifying apparitions in the sky. The literature dealing with such experiences is enormous. The word "spectre" is used generically to describe phenomena of this type. This word's earliest use, cited in the Oxford English Dictionary (OED), is in the title of a book by Z. Jones published in 1605, "A Treatise of Specters or straunge Sightes, Visions and Apparitions appearing sensibly unto men." The word "spectrum" is cited first in 1611 in a passage which said, "Walsingham hath written of a fatal Spectrum or Apparition . . . where sundry monsters of diuers colours . . . were seen." Sixty years later, Isaac Newton used the word to describe his decomposition of sunlight with a glass prism in these words, "The Sunbeams . . . passing through a glass prism to the opposite Wall, exhibited there a Spectrum of diuers colours."

From these two uses of the word "spectrum" comes naturally the two meanings which the OED gives for the word "spectrology": (1) The science or study of spectres, and (2) The scientific study of spectra. The OED cites as an example of the first meaning an 1820 quote from Washington Irving's "Sketchbook": "The gloom of religious abstraction, and the wildness of their situation . . . had filled their imaginations with the frightful chimeras of witchcraft and spectrology." And of the second, an 1862 quote from the "American Journal of Sci-

ence": "The attention of the French scientific world is wholly fixed on spectrology, for thus do they designate the experiment with the spectroscope of Bunsen and Kirchhoff."

I am the second man in human history to have written a book on spectrology in both of these two distinct meanings. Donald Menzel was the first.

FLYING SAUCERS

Modern interest in UFOs stems mainly from the observations of Kenneth Arnold, a Boise, Idaho, businessman on June 24, 1947. While flying near Mt. Rainier in Washington he reported seeing some objects skimming along which he described in a manner that led newspapermen to call them "flying saucers." Although not all objects later reported are saucer-shaped, this term is often used generically, but the term UFO is preferable. The Air Force studies anything seen flying in the sky which might present a defense hazard, and thus has been concerned with the thousands of reports of sightings of UFOs that have come to them in the nearly 22 years since this first modern report.

From such study they concluded long ago that no defense problem was involved in these reports from the public. The amount of attention which the Air Force gave to the problem after the first four or five years has been minimal.

In the early '50s the story of UFOs began to appear in sensational pseudoscience magazine articles and paperback books. These have had a large sale. The book by Frank Edwards, "Flying Saucers—Serious Business," probably holds the record with more than 1,300,000 copies sold. Several other titles have sold more than 200,000 copies. The so-called Condon report was given an initial printing of 200,000 copies. In the last three years 40,000 school children have written the Air Force asking for UFO data.

The principal source of the widespread interest is the contention of some writers that at least some of the

things seen may represent flying craft from other civilizations, either elsewhere in the solar system, or even from a planetary system associated with some other star.

We must be extremely careful about our language. Some UFOs may be such visitors, it may be postulated, and some writers go so far as to say that they actually are. To discover clear, unambiguous evidence on this point would be a scientific discovery of the first magnitude, one which I would be quite happy to make. We found no such evidence, and so state in our report. But it is not true to say that we "proved that flying saucers do not come from outer space." All that can be said is that, of the cases we looked into carefully, we found no evidence in support of the hypothesis of their extra-terrestrial origin.

STUDY ADVISABLE

We concluded that it is not worthwhile to carry on a continuing study of UFOs in the manner which has been done thus far: that of going out into the field to interview persons who say they have seen something peculiar. The difficulty about using objective means of study lies in the rarity of the apparitions, their short duration, and the tendency of observers not to report their experience until long after it has ended. When a known object is the source of many reports, as in the case of the Zond IV re-entry of March 3, 1968, there is extraordinary disagreement among the descriptions of what was seen by different observers of the same event. This result shows that no great certainty attaches to the specific details of any of the reports.

These difficulties led us to conclude that it is quite unproductive of results of scientific value to study UFOs in the traditional manner. But, contrary to popular belief, we do not rule out all future study. We say: "Although we conclude after nearly two years of intensive study, that we do not see any fruitful lines of advance from the study of UFO reports, we believe that any scientist with adequate training and

credentials who does come up with a clearly defined, specific proposal for study should be supported."

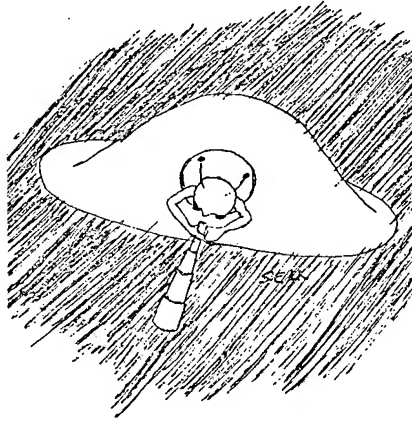
This conclusion has been bitterly denounced by the flying saucer buffs who have been making money from sensational writing and lecturing to gullible audiences, and collecting dues from the membership of their pseudo-science organizations. One prominent professor of atmospheric physics has been giving speeches in which he advocates that the federal government spend on UFO study amounts of money which would "dwarf" that spent on the space program.

Even though nearly a year has gone by since my work in this field ended, I continue to be astonished at the fervor with which many people hold views that are totally unsupported by objective evidence of any kind. Many people seem quite incapable of recognizing any distinction between what might be so and what actually is so. Some of these are charlatans, in my opinion, who profess belief in order to collect royalties from writing and fees from lecturing. But others are deeply sincere.

THE CULTISTS

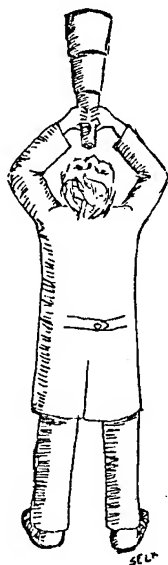
We ran into many more interesting cases than we could include in the report, already criticized by many for being too thick. There was a young airman, second class, at an Air Force base in New Mexico whose 19-year-old wife died suddenly of a heart attack. They were members of a flying saucer cult which gathered around and decided that the woman's spirit had gone to Venus on a flying saucer, and that she would want her body back when she returned. So they wrapped it in a sheet and stored it in a barn rather than having it properly buried. The police learned of this by a mysterious postcard from a woman in Spokane, Washington. At first they thought the card was a hoax, but investigation proved that the young woman's body had been by this time stored in that barn for about three weeks. The young airman had seen lots of flying saucers but had not reported any of them, saying: "I didn't know the Air Force was interested!"

In the spring of 1967 I was visited several times by a well-mannered man who claimed to be acting as agent for the Third Universe (we are the First,



and the Second is inhabited by beings that resemble polar bears, he said). He said he was authorized to negotiate a contract with the U.S. government by which they would teach us to make inter-stellar flying saucers for \$3 billion. The first billion was to be paid after a demonstration to government officials at Dulles airport, the second after a major national laboratory had been built and our scientists and technologists had learned how to make flying saucers, and the third after they had trained our flight crews in inter-stellar navigation. He was specific down to the point of naming the bank in Arlington, Virginia, where the \$3 billion was to be deposited.

He wanted me, in the interim, to pay him \$3,000 as "earnest money" to be deposited in a particular bank in Western Colorado to the account of his organization, which was called the "Omnific Intelligence Continuum." Inquiry to that bank revealed that there really was such an account. Asked the size of the account the



banker cautiously said, "Small sums go in and out." Asked about membership of the organization the banker told me, "So far as I know Mr. X is the only member." Since part of Mr. X's story is thus verified, ought we now to believe everything he tells us?

REAL OR PSEUDO-SCIENCE

The most vivid lesson that I learned from such experiences is what a narrow, wobbly line there is between real science and pseudo-science. So far as the public is concerned most of the science which they know about they do not understand. Very few people can state clearly the grounds for belief that the Earth goes around the Sun, rather than vice versa, or for that matter, for our belief that the Earth is a ball rather than flat. Coming to more modern instances, who among the many investors in the profitable semiconductor industries have the slightest idea how a transistor works really?

In the given circumstances most of the scientific ideas that are accepted by the public are accepted entirely on faith. To most people, completely lacking any basic understanding of underlying principles, the proposition that the configuration of the planets and stars at the time of our birth determines the course of events in our lives, seems no more unlikely or preposterous than many of the well-established truths of science which they do accept without understanding them. There are some 10,000 astrologers in America who make their living practicing astrology and only about 2,000 astronomers who live by practicing astronomy. If celestial matters were decided democratically by the members of both professions lumped together, then the "real" astronomers would always end up as a depressed minority.

Flying saucers and astrology are not the only pseudo-sciences which have a considerable following among us. There used to be spiritualism, there continues to be extrasensory perception, psychokinesis, and a host of others. Hanson W. Baldwin in the "New York Times" has told how the Marines at Camp Pendleton are trained for Vietnam in the use of dowrs made of bent wire coathangers as a means of locating tunnels and other underground works of the Viet Cong.

Recently a visitor from a Navy research installation told me that some

MARGARET MEAD

Public Policy and Behavioral Science

admirals had purchased from an inventor a wholly worthless invention which it was claimed could detect submerged submarines by a radar-like reflection of electromagnetic waves. This could not possibly work because of the conductivity of sea water, and it did not work when expensively tested. A test had to be made to satisfy the admirals and certain congressmen. A Russian spy in the same Navy laboratory got hold of the invention and our test results and sent them to Russia. The Russians did more work on the invention. Although they understood at once that it must be foolish, they thought they might be wrong because the Americans had spent so much time and money studying this crackpot invention. We know about this because an American spy in their laboratory sent to us the story of their work.

These and many other examples that could be given show that we have failed rather miserably to give even to so-called educated people some feeling for the way in which science investigates a subject, and the way in which scientists subject their observational material to critical evaluation before reaching conclusions. The thing that most people are least able to do is to refrain from drawing conclusions when there is not enough evidence at hand to warrant drawing conclusions.

In ancient times, the future was foretold in many ways that have gone out of favor, such as by examining the entrails of sacrificed animals, or basing omens on the study of the flight of flocks of birds. (Cicero practiced this latter method.) Before you smile, bear in mind that these views have never really had as much scientific study as have the UFO reports. Perhaps we need a National Magic Agency to make a large and expensive study of all these matters, including the future scientific study of UFOs, if any.

Where corruption of children's minds is at stake, I do not believe in freedom of the press or freedom of speech. In my view, publishers who publish or teachers who teach any of the pseudo-sciences as established truth should, on being found guilty, be publicly horsewhipped, and forever banned from further activity in these usually honorable professions. Truth and children's minds are too precious for us to allow them to be abused by charlatans.

I am testifying out of long experience in the application of anthropology to contemporary national and international problems. During World War II, I worked within the context of the National Research Council on problems of nutrition, national morale, civilian defense, and cross national communication with Great Britain. I was one of the group that developed anthropological work on cultures at a distance—notably Germany and Japan—and after World War II, I participated in and directed a series of studies on behalf of the Office of Naval Research, Rand and MIT, including studies on the Soviet Union, China and France. These were interdisciplinary team activities (summarized in "The Anthropology of Human Conflict," Mead and Metraux in "The Nature of Human Conflict," edited by Elton B. McNeil, Prentice Hall, Inc. 1965). Since 1952 I have devoted myself to the study of technical assistance and political implications of culture change, education, cross national and international order and control of warfare, population control, environmental control, urbanization, cross ideological communication, and recently to the world wide implications of the generation gap.

I am here to discuss the possible contributions that the behavioral sciences together, and anthropology in particular, can contribute to national and international affairs.

During World War II we made a fine start in the utilization of this group of young sciences on a whole series of problems ranging from obtaining a better understanding of the national cultures of our opponents, our allies and ourselves, to the deter-

Physical scientists have been vocal and highly influential in Washington in the shaping of public policy on a number of fronts since the end of World War II. But what has become of the influence of behavioral scientists in Congress and on Capitol Hill? Margaret Mead discusses the question in this excerpt from her testimony before the U.S. Senate Foreign Relations Committee June 20, 1969 in "a hearing on the psychological aspects of public policy. Dr. Mead is Curator of Ethnology at the American Museum of Natural History and Adjunct Professor of Anthropology at Columbia University.

mination of specific policies within the armed forces and within the nation, from the prediction of how Japan would respond to our treatment of the Emperor, to a clarification of relationships between the United States and our principal allies, to an illumination of the ambiguities in the responses of the various occupied countries to problems of civilian morale, to the maintenance of the health of the nation, to an unprecedented mobilization of our industrial resources, and to a deployment of resources in post war rehabilitation of a badly wounded world. These successes were accomplished under a set of conditions which can be clearly specified: a state of preparedness, mobilization and post war activity made possible by almost total commitment to a war which could be seen as a moral effort against almost overwhelming power and risk; a willingness of the community of behavioral scientists to give unstintingly of time and effort, within and without government,

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Beings from Outer Space—Corporeal and Spiritual

Since World War II, concern with UFO's from outer space, controlled by intelligent beings, bears much resemblance to concern with the so-called physical phenomena of psychic research after World War I. Spiritualistic mediums claimed they could produce movements of objects by supernatural forces, including the production of ectoplasmic emanations from their bodies. Today this nonsense is pretty much forgotten but these manifestations reverberated in the press during the 1920's and 1930's and were regarded by many as proof of communication with beings from another world in the form of spirits of deceased persons. Belief in this sort of thing involved many professional people including some distinguished scientists, clergymen, physicians, writers, and men of affairs, and the psychic research societies published numerous supporting papers of a pseudoscientific nature.

A famous case was that of a Boston medium in the 1920's, who had a wide following. She was the wife of an eminent surgeon and claimed communication with her dead brother. The old *Scientific American* magazine had offered a prize of \$5000 to anyone who could demonstrate supernormal physical phenomena to a committee of its choosing. At her request, she was investigated in 1924 by this committee, composed of several Harvard and M.I.T. professors along with Harry Houdini, the magician. The committee reported that evidence for her supernormal powers was inconclusive, although Houdini denounced her as fraudulent. Following wide press publicity, a group at Harvard, of which I was one, later investigated her in a series of seances in the psychological laboratories and found not only that the phenomena were due to trickery, but also how the tricks were done. Our findings, published in an article by me in the *Atlantic Monthly* of November 1925, resulted in violent recriminations and denunciations of us in published pamphlets and press statements by her followers. Our exposure enhanced her publicity, and she gained more adherents. She was skillful in modifying her mode of operation, depending upon the gullibility of her audience and other circumstances. On several subsequent occasions she was also exposed by other scientists, but at no time until her death did she lose a diminishing circle of devoted believers.

The basic difficulty inherent in any investigation of phenomena such as those of psychic research or of UFO's is that it is impossible for science ever to prove a universal negative. There will be cases which remain unexplained because of lack of data, lack of repeatability, false reporting, wishful thinking, deluded observers, rumors, lies, and fraud. A residue of unexplained cases is not a justification for continuing an investigation after overwhelming evidence has disposed of hypotheses of supernormality, such as beings from outer space or communications from the dead. Unexplained cases are simply unexplained. They can never constitute evidence for any hypothesis. Science deals with probabilities, and the Condon investigation adds massive additional weight to the already overwhelming improbability of visits by UFO's guided by intelligent beings. The Condon report rightly points out that further investigations of UFO's will be wasteful. In time we may expect that UFO visitors from outer space will be forgotten, just as ectoplasm as evidence for communication with the dead is now forgotten. We may also anticipate, however, that many present believers will continue to believe for their own psychological reasons, which have nothing to do with science and the rules of evidence.—HUDSON HOAGLAND, *President Emeritus, Worcester Foundation for Experimental Biology*, and *Member, AAAS Board of Directors*